What is claimed is:

1. A method of generating repetitive pulsed radiation with a multiplicity of discrete wavelengths,

   the method comprising:

   positioning an optical processing medium in a resonant cavity with reflective elements;

   and

   generating repetitive pulsed radiation from a pulsed laser source in a pump cavity with reflective elements;

   and

   coupling the resonant and pump cavities;

   and

   seeding the optical processing medium with at least some of the discrete wavelengths, such that pulsed radiation with a multiplicity of discrete wavelengths is generated.

2. The method of claim 1, wherein the optical processing medium has zero dispersion centered on the desired multiplicity of wavelengths.

3. The method of claim 1, wherein the optical processing medium is highly non-linear medium.

4. The method of claim 1, wherein the optical processing medium is dispersion shifted medium.

5. The method of claim 1, wherein the optical processing medium is dispersion shifted fiber.

6. The method of claim 1, wherein the optical processing medium is photonic crystal.

7. The method of claim 1, wherein the optical processing medium is photonic crystal fiber.

8. The method of claim 1, wherein the optical processing medium has reflective elements at both ends to comprise the resonant cavity.

9. The method of claim 1, wherein the optical processing medium has other reflective elements which reflect a portion of at least some of the multiplicity of discrete wavelengths.

10. The method of claim 9, wherein the wavelength values that these reflective elements reflect correspond to at least some wavelengths on a standard grid.

11. The method of claim 10, wherein the standard grid is an optical communications ITU grid.

12. The method of claim 1, wherein the repetition rate of the pulsed laser source is harmonically related to the desired frequency separation of the set of wavelengths to be generated.

13. The method of claim 1, wherein the pump cavity is a resonant cavity with a round trip time harmonically related to the repetition rate of the optical pulses from the pulsed laser source.

14. The method of claim 1, wherein the signal determining the repetition rate of the pulsed laser source is derived from the optical pulse output from at least one of the cavities.

15. The method of claim 1, wherein the repetition rate of the pulsed laser source is maintained at fixed value by means of feedback circuitry, a control mechanism and a stable reference.

16. The method of claim 15, wherein the control mechanism is temperature control.

17. The method of claim 1, wherein the pulsed laser source is a pulsed laser diode.

18. The method of claim 1, wherein the pulsed laser source is a gain switched laser diode.

19. The method of claim 18, wherein the gain switched laser diode receives a current pulse from circuitry containing a step recovery diode and an RF source.

20. The method of claim 1, wherein the pulsed laser source is a mode locked laser source

21. The method of claim 1, wherein the peak power of the pulsed output of the pulsed laser source is increased by compressing the temporal duration of the pulses.

22. The method of claim 21, wherein the temporal compression of the pulses is achieved by means of saturable absorption.

23. The method of claim 21, wherein the temporal compression of the pulses is achieved by means of diffraction gratings.

24. The method of claim 21, wherein the temporal compression is achieved by means of distributed fiber diffraction grating.

25. The method of claim 21, wherein the temporal compression is achieved by means of at least one non linear fiber loop.

26. The method of claim 1, wherein the pulsed laser source is stabilized to emit radiation at a specific wavelength.

27. The method of claim 26, wherein the pulsed laser source is wavelength stabilized by means of seeding by a wavelength stabilized laser.

28. The method of claim 13, wherein the pulsed laser source in a resonant pump cavity is wavelength stabilized by means of a reflective Bragg grating in the resonant cavity.

29. The method of claim 1, wherein the pump cavity is coupled to the resonant cavity by means of fiber coupling.

30. The method of claim 1, wherein the pump cavity is coupled to the resonant cavity by means of waveguide elements.

31. The method of claim 1, wherein the resonant cavity and the pump cavity are coupled interferometrically to transfer substantially all the pump radiation to the resonant cavity and to prevent radiation at the pump wavelength from emerging from the resonant cavity at the coupler.

32. The method of claim 1, wherein the resonant cavity and the pump cavities are coupled by being co-located as a single resonant cavity, which is comprised of the laser source, the optical processing medium and reflective elements.

33. The method of claim 1, wherein at least one reflective element is a facet of a laser source.

34. The method of claim 1, wherein at least one reflective element is an end of the optical processing medium.

35. The method of claim 1, wherein the reflective elements are distributed Bragg gratings.

36. The method of claim 1, wherein one reflective element is designed so that it is highly reflective at the wavelengths of the generated set and at the wavelength of the laser source.

37. The method of claim 1, wherein at least one of the reflective elements transmits an equal amount of each wavelength in the generated set of wavelengths.

38. The method of claim 1, in which the pump radiation coupled into the resonant cavity generates other wavelengths by means of wave mixing in the non-linear medium.

39. The method of claim 1, wherein at least some of the reflective elements of the resonant cavity reflect a portion of at least some of the multiplicity of discrete wavelengths in a manner that is synchronous with the pump to seed the generation of these reflected wavelengths.

40. The method of claim 1, wherein two low power continuous wave laser diode sources are also coupled into the resonant cavity to seed generation of higher power pulsed radiation at the wavelengths of the two low power laser diodes, said higher powered pulsed radiation being powered by the pump radiation.

41. The method of claim 1, wherein the seed wavelengths generate additional wavelengths of the multiplicity discrete wavelengths.

42. The method of claim 1, wherein the multiplicity of wavelengths generated correspond to wavelengths on a standard grid.

43. The method of claim 42 wherein the standard grid is an optical communications ITU grid.

44. The method of claim 1, wherein the cavities include waveguide elements.

45. The method of claim1, wherein at least the resonant cavity is a waveguide resonant cavity.

46. The method of claim 1, wherein the resonant cavity has a fiber coupled output.

47. An apparatus for generating repetitive pulsed radiation with a multiplicity of discrete wavelengths,

the apparatus consisting of:

an optical processing element with reflective elements, said optical processing element optically coupled to the optical processing element operable in a multiple pass resonant manner;

and

seeding elements operable in the optically processing element to initiate generation of at least some of the discrete wavelengths;

and

an optically active element (WHY CAN THIS NOT BE CALLED A PULSED LASER SOURCE ??) with reflective elements operable to generate repetitive pulsed pump radiation, said optically active element optically coupled to the optical processing element,

and

operable to transmit such repetitive pulsed pump radiation to the optical processing element, such that repetitive pulsed radiation with a multiplicity of discrete wavelengths is generated.

48. The apparatus of claim 47, wherein the optical processing medium has zero dispersion centered on the desired multiplicity of wavelengths.

49. The apparatus of claim 47, wherein the optical processing medium is highly non-linear medium.

50. The apparatus of claim 47, wherein the optical processing medium is dispersion shifted medium.

51. The apparatus of claim 47, wherein the optical processing medium is dispersion shifted fiber.

52. The apparatus of claim 47, wherein the optical processing medium is photonic crystal.

53. The apparatus of claim 47, wherein the optical processing medium is photonic crystal fiber.

54. The apparatus of claim 47, wherein the optical processing medium has reflective elements at both ends enabling said optical processing medium to operate in a multiple pass resonant manner.

55. The apparatus of claim 47, wherein the optical processing medium has other reflective elements operable to reflect a portion of at least some of the multiplicity of discrete wavelengths.

56. The apparatus of claim 55, wherein the wavelength values that these reflective elements reflect correspond to at least some wavelengths on a standard grid.

57. The apparatus of claim 56, wherein the standard grid is an optical communications ITU grid.

58. The apparatus of claim 47, wherein the repetition rate of the repetitive pulsed pump radiation is harmonically related to the desired frequency separation of the set of wavelengths to be generated.

59. The apparatus of claim 47, wherein the optically active element is operable in a resonant manner with a round trip time harmonically related to the repetition rate of the repetitive pulsed pump radiation from the optically active element.

60. The apparatus of claim 47, wherein the signal determining the repetition rate of the optically active element is derived from the at least some of the repetitive pulsed radiation .

61. The apparatus of claim 47, wherein the repetition rate of the repetitive pulsed radiation is maintained at fixed value by means of feedback circuitry, a control mechanism and a stable reference.

62. The apparatus of claim 61, wherein the control mechanism is temperature control.

63. The apparatus of claim 47, wherein the optically active element is a pulsed laser diode.

64. The apparatus of claim 47, wherein the optically active element is a gain switched laser diode.

65. The apparatus of claim 64, wherein the gain switched laser diode receives a current pulse from circuitry containing a step recovery diode and an RF source.

66. The apparatus of claim 47, wherein the optically active element is a mode locked laser source

67. The apparatus of claim 47, wherein the peak power of the pulsed output of the optically active element is increased by compressing the temporal duration of the pulsed radiation.

68. The apparatus of claim 67, wherein the temporal compression of the pulsed radiation is achieved by means of saturable absorption.

69. The apparatus of claim 67, wherein the temporal compression of the pulsed radiation is achieved by means of diffraction gratings.

70. The apparatus of claim 67, wherein the temporal compression of the pulsed radiation is achieved by means of distributed fiber diffraction grating.

71. The apparatus of claim 67, wherein the temporal compression of the pulsed radiation is achieved by means of at least one non linear fiber loop.

72. The apparatus of claim 47, wherein the optically active element is stabilized to emit radiation at a specific wavelength.

73. The apparatus of claim 72, wherein the optically active element is wavelength stabilized by means of seeding by a wavelength stabilized laser.

74. The apparatus of claim 72, wherein the optically active element is wavelength stabilized by means of a reflective Bragg grating.

75. The apparatus of claim 47, wherein the optically active element is coupled to the optical processing element by means of fiber coupling.

76. The apparatus of claim 47, wherein the optically active element is coupled to the optical processing element by means of waveguide elements.

77. The apparatus of claim 47, wherein the optically active element and the optical processing element are coupled interferometrically operable to transfer substantially all the repetitive pulsed pump radiation to the optical processing element and operable to prevent said radiation from emerging from the optical processing element at the coupler.

78. The apparatus of claim 47, wherein the optical processing element and the optically active element are coupled by means of both being positioned between reflective elements, said reflective elements operable to confine predetermined amounts of the repetitive pulsed pump radiation and the repetitive generated pulsed radiation.

79. The apparatus of claim 47, wherein at least one reflective element is a facet of a laser source.

80. The apparatus of claim 47, wherein at least one reflective element is an end of the optical processing medium.

81. The apparatus of claim 47, wherein the reflective elements are distributed Bragg gratings.

82. The apparatus of claim 47, wherein one reflective element is highly reflective at the wavelengths of the generated set and at the wavelength of the laser source.

83. The apparatus of claim 47, wherein at least one of the reflective elements transmits an equal amount of each wavelength in the generated set of wavelengths.

84. The apparatus of claim 47, in which the repetitive pulsed pump radiation coupled into the optical processing medium operable to generate other wavelengths by means of wave mixing in the non-linear medium.

85. The apparatus of claim 47, wherein at least some of the reflective elements reflect a portion of at least some of the multiplicity of discrete wavelengths operable in a manner that is synchronous with the repetitive pulsed pump radiation

86. The apparatus of claim 47, wherein at least some of the reflective elements reflect a portion of at least some of the multiplicity of discrete wavelengths operable in a manner that seeds the generation of these reflected wavelengths.

87. The apparatus of claim 47, wherein two low power continuous wave laser diode sources are also coupled to the optical processing medium, operable as seeding elements to seed generation of higher power pulsed radiation at the wavelengths of the two low power laser diodes, said higher powered pulsed radiation being powered by the repetitive pulsed pump radiation.

88. The apparatus of claim 87, wherein the seeding wavelengths are seeding elements operable to generate additional wavelengths of the multiplicity discrete wavelengths.

89. The apparatus of claim 47, wherein the multiplicity of wavelengths generated correspond to wavelengths on a standard grid.

90. The apparatus of claim 89, wherein the standard grid is an optical communications ITU grid.

91. The apparatus of claim 47, wherein the optical processing element includes waveguide elements.

92. The apparatus of claim 47, wherein the optically active element includes waveguide elements.

93. The apparatus of claim 47, wherein the optical processing element has a fiber coupled output.

94. A means of generating repetitive pulsed radiation with a multiplicity of discrete wavelengths, comprising:

means for positioning an optical processing medium in a resonant cavity with reflective elements;

and

means for generating repetitive pulsed radiation from a pulsed laser source in a pump cavity with reflective elements;

and

means for coupling the resonant and pump cavities;

and

means for seeding the optical processing medium with at least some of the discrete wavelengths, such that pulsed radiation with a multiplicity of discrete wavelengths is generated.